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60TH CONGRESS, { HOUSE OF REPRESENTATIVES. { DOCUMENT
2d Session. } No. 1488.

U. S. Army, Corps of Engineers

JAMAICA BAY, AND ROCKAWAY AND DEAD HORSE INLETS
NEW YORK.

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LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS OF
EXAMINATION AND SURVEY OF JAMAICA BAY, ROCKAWAY
INLET, AND WATERS HAVING OUTLET IN DEAD HORSE INLET,
NEW YORK.

FEBRUARY 27, 1909.—Referred to the Committee on Rivers and Harbors and ordered
to be printed, with illustration.

WAR DEPARTMENT,
Washington, February 26, 1909.

SIR: I have the honor to transmit, herewith, a letter from the
Chief of Engineers, U. S. Army, dated 25th instant, together with
copies of reports from Col. John G. D. Knight, Corps of Engineers,
dated August 3, 1907, and January 30, 1909, with map, of a prelim-
inary examination and survey, respectively, of Jamaica Bay, Rock-
away Inlet, and waters having outlet in Dead Horse Inlet, New York,
made by him in compliance with the provisions of the river and
harbor act of March 2, 1907.

Very respectfully,

LUKE E. WRIGHT,
Secretary of War.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

WAR DEPARTMENT,
U. S. OFFICE OF THE CHIEF OF ENGINEERS,
Washington, February 25, 1909.

SIR: I have the honor to submit herewith for transmission to
Congress reports of August 3, 1907, and January 30, 1909, with
map, by Col. John G. D. Knight, Corps of Engineers, on preliminary
examination and survey, respectively, authorized by an item in

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section 3 of the river and harbor act approved March 2, 1907, as follows:

The waters of Jamaica Bay, including entrance to said bay at Rockaway Inlet and those waters having their outlet in Dead Horse Inlet, with a view to framing a plan for their improvement and recommending the order of such improvement with the cost thereof, and to recommend the proportion of such cost to be borne by the city of New York; and the Secretary of War is hereby requested to confer and cooperate with the commissioner of docks and ferries of the city of New York, or with any other duly authorized agents, officers, or representatives of the city of New York, and with any commission of engineers appointed, or who shall hereafter be appointed, to survey or examine said bay and to recommend to the city of New York, plans for the improvement of said Jamaica Bay or the lands in and about said bay.

The object of the proposed improvement contemplated by this item of the act is to provide a substantial increase in the harbor facilities for the commerce centering at New York City. Jamaica Bay is a broad, shallow body of water and the improvement necessary to make it available for deep-draft vessels amounts practically to the construction of an artificial harbor. The portion of the work which it is proposed shall be undertaken by the General Government is the construction of the entrance channel and the main interior channel, leaving to the local authorities the work of providing secondary channels and basins, piers, bulkheads, etc.

The cost (in round numbers) of the work to be done by the United States is estimated by the local officer at \$8,610,000; for the reasons given in its report of February 23, 1909 (also herewith), the Board of Engineers for Rivers and Harbors reduces this estimate to \$7,430,000. It is noted, however, that in both these estimates one item amounting to \$589,500, and possibly a second amounting to \$724,500, may be found to be unnecessary, in which case the total estimated cost would be reduced to about \$6,000,000 and \$5,000,000, respectively.

The cost of the work to be borne by the city of New York is variously estimated at \$13,565,360, \$47,089,375, and even as much as \$70,000,000.

The order in which it is proposed that the work to be done by the General Government shall be prosecuted, if authorized, is given in detail in the reports of the local officer and of the Board of Engineers for Rivers and Harbors. In brief, it is, first, to obtain and maintain an entrance channel 18 feet deep and 500 feet wide, this work not to be inaugurated until the Secretary of War is satisfied that the city of New York is prepared to undertake its share in the proposed improvement; second, when required by the demands of commerce, to enlarge the entrance channel to a depth of 30 feet and a width of 1,500 feet and the main interior channel to a depth of 30 feet and a width of 1,000 feet. If found by experience to be advisable, jetties are to be constructed to aid in maintaining the entrance channel.

I concur in the opinion of the district officer and the Board of Engineers for Rivers and Harbors that this locality is worthy of improvement in accordance with some progressive plan for joint prosecution by the United States and the local authorities; but it is also my opinion that the United States should not at this time be committed further than to a project for securing a depth of 18 feet, as provided in the first step of the progressive improvement recommended in the reports herewith. Any further improvement should be clearly shown to be in the interests of commerce, and the next step might properly provide for lesser depths than the 30 feet pro-

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posed by the second step in the plan now presented, and for a corresponding reduction in cost to the United States. In any event, the total ultimate cost to the United States for the improvement of this locality should not exceed the amount of the estimate submitted by the Board of Engineers for Rivers and Harbors for channels of the maximum dimensions contemplated by the reports herewith, namely, \$7,430,000, plus the cost of maintaining the entrance channel.

In the course of these investigations and the preparation of his report, Colonel Knight conferred freely with the Jamaica Bay Improvement Commission, which was appointed by the mayor of New York for this purpose, such conferences being held in conformity with the terms of the act as quoted above.

Very respectfully,

W. L. MARSHALL,
Chief of Engineers, U. S. Army.

The SECRETARY OF WAR.

PRELIMINARY EXAMINATION OF JAMAICA BAY, NEW YORK, INCLUDING ITS ENTRANCE AT ROCKAWAY INLET AND THE WATERS HAVING OUTLET IN DEAD HORSE INLET.

UNITED STATES ENGINEER OFFICE,
New York City, August 3, 1907.

SIR: I have the honor to submit the following report upon a preliminary examination of Jamaica Bay at Rockaway and Dead Horse inlets, etc., made in compliance with department letter, dated March 4, 1907, and pursuant to the requirements of the river and harbor act of March 2, 1907, of which the following is an extract:

The waters of Jamaica Bay, including entrance to said bay at Rockaway Inlet and those waters having their outlet in Dead Horse Inlet, with a view to framing a plan for their improvement and recommending the order of such improvement with the cost thereof, and to recommend the proportion of such cost to be borne by the city of New York; and the Secretary of War is hereby requested to confer and cooperate with the commissioner of docks and ferries of the city of New York, or with any other duly authorized agents, officers, or representatives of the city of New York, and with any commission of engineers appointed, or who shall hereafter be appointed, to survey or examine said bay and to recommend to the city of New York, plans for the improvement of said Jamaica Bay or the lands in and about said bay.

Attention is invited to United States Coast and Geodetic Survey chart No. 120, the Brooklyn quadrangle of the United States Geological Survey map, and the map accompanying House Document No. 442, Fifty-ninth Congress, second session.

United States river or harbor work in Jamaica Bay has for some time been limited to providing two dikes and dredging between them to secure a 6-foot channel of from 100 to 150 feet width, connecting the steamboat dock at Canarsie with Big Channel, and dredging two channels 50 feet wide and 4 or 5 feet deep running southwesterly and northeasterly from Canarsie Landing.

An examination and survey across the bar lying west of Rockaway Inlet to deep water in Jamaica Bay, with a view to estimating the cost of securing a channel 20 feet deep and 600 feet wide at low tide, was reported upon December 31, 1906, but at that time it was deemed not

advisable for the United States to undertake the improvement of Rockaway Inlet.^a

But what was deemed inadvisable then may be advisable to consider more favorably now that a commission appointed by the mayor of New York has reached among other conclusions the following:

That most of that portion of the shore front of Manhattan which is adapted to business is now in use, that greater facilities can only be secured at enormous expense, and furthermore, that even these improvements will do little to relieve the present congestion.

That as a result of the above we believe that the time is fast approaching when the city will be compelled to make use of portions of the water front in other boroughs, and that for business reasons, if for no other, steps in this direction should at once be taken.

That it is our opinion that no place in any part of Greater New York offers greater opportunities for profitable investments than the territory in Jamaica Bay.

The commission recommended that such city officials as are delegated to represent the city in the conference to be held with the federal authorities in this matter of the Jamaica Bay improvement be instructed to urge strongly upon the War Department the necessity of the army engineers again taking up the question of improving Rockaway Inlet; also that the Federal Government be strongly urged to defray the expense of a 1,000-foot channel within Jamaica Bay.

This commission expired last May, after reporting upon the general improvement and development of Jamaica Bay, and also upon the condition of the water front of the city of New York other than that of Manhattan Island; but a new commission having the same membership as the former commission has been appointed, with instructions to confer with the Secretary of War relative to the survey or examination of Jamaica Bay and to recommend plans for the improvement thereof.

In my opinion a further examination and survey of the waters of Jamaica Bay, including entrance to said bay at Rockaway Inlet and those waters having their outlet in Dead Horse Inlet, is justified not only by the prospective development of New York City within the limits of Jamaica Bay, but also because without such examination and survey it will be impracticable to frame a plan for the improvement of these waters and recommend the "order of such improvement with the cost thereof, and to recommend the proportion of such cost to be borne by the city of New York," as contemplated by the provisions of the act of March 2, 1907.

I recommend that such examination and survey be authorized and that the sum of \$4,500 be allotted to meet the cost thereof.

Very respectfully, your obedient servant,

JOHN G. D. KNIGHT,
Colonel, Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. Army.

^a See House Document No. 442, Fifty-ninth Congress, second session.

[Second indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., August 12, 1907.

Respectfully returned to the Chief of Engineers, U. S. Army.

The object of this examination is explained by the wording of the act, which involves the general improvement of Jamaica Bay and its entrance through Rockaway Inlet. The district officer is of opinion that a further examination and survey are justified, not only by the prospective development of New York City within the limits of Jamaica Bay, but also because such further examination and survey are necessary in order to frame a plan for the improvement contemplated and to recommend the order of such improvement, with the cost thereof, as directed in the act.

Under an act of Congress, approved June 28, 1906, an examination and survey of Rockaway Inlet to deep water in Jamaica Bay was made and reported upon unfavorably by the district officer. The Board of Engineers for Rivers and Harbors, in reviewing said report, concurred in the views of the district officer, and stated that "the commerce of Jamaica Bay is considerable and would be somewhat benefited by a stable and deeper channel through the inlet. The extent of the benefits would, however, appear to be limited to a small part of the total commerce of the bay for the reason that outside of Rockaway Beach itself there are few, if any, localities of importance where the available navigable depth exceeds the natural depth at the inlet." The examination at that time contemplated only the improvement at the entrance to the bay and not the improvement of any part of the bay itself or its tributary channels, and by reason of this limitation would have been of little value, as deep-draft boats entering through an improved inlet could not have reached any of the several ports within the bay.

The scope of the present examination is very much more extensive than the one just referred to, involving not only the improvement of the entrance to the bay, but of the entire bay itself, one of the main objects of the investigation being to provide additional wharf and dockage facilities for the congested commerce of New York City, this location being the best available for such development.

Having in mind the great importance of the questions involved in this examination, and of the necessity of a survey in order to frame a comprehensive plan of improvement with an estimate of the cost thereof, as required by the act, the Board concurs with the district officer in recommending that a survey be authorized.

For the Board:

D. W. LOCKWOOD,
Colonel, Corps of Engineers,
Senior Member of the Board.

[Third indorsement.]

WAR DEPARTMENT,
 OFFICE OF THE CHIEF OF ENGINEERS,
Washington, August 16, 1907.

Respectfully submitted to the Secretary of War.

This is a report on preliminary examination of the waters of Jamaica Bay, including the entrance to said bay at Rockaway Inlet,

etc. (the full text of the item being quoted within), authorized by the river and harbor act of March 2, 1907.

Inviting attention to the report of the Board of Engineers for Rivers and Harbors in the preceding indorsement, I recommend that a survey of the locality as proposed be authorized.

If this recommendation receive favorable consideration by the Secretary the district officer will be directed, pursuant to the provisions of the within-quoted item of law, to cooperate with the proper officials of the city of New York in connection with the preparation of a plan and estimate of cost of improvements contemplated. No communication on the subject has as yet been received in this office from the officials of New York City.

A. MACKENZIE,
Brig. Gen. Chief of Engineers, U. S. Army.

[Fourth indorsement.]

WAR DEPARTMENT,
August 19, 1907.

Approved as recommended by the Chief of Engineers in the preceding indorsement.

ROBERT SHAW OLIVER,
Acting Secretary of War.

SURVEY OF JAMAICA BAY, NEW YORK, INCLUDING ITS ENTRANCE
AT ROCKAWAY INLET, AND THE WATERS HAVING OUTLET IN DEAD
HORSE INLET.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
New York City, January 30, 1909.

SIR: August 3, 1907, I submitted a report upon a preliminary examination of Jamaica Bay at Rockaway and Dead Horse inlets, etc., in which I recommended a further examination and survey. August 19, 1907, the Secretary of War authorized this survey;
* * *

I now have the honor to submit the following final report and accompanying map of the survey.

By section 3 of the river and harbor act of March 2, 1907, the Secretary of War was directed to cause a preliminary examination or survey to be made of—

The waters of Jamaica Bay, including entrance to said bay at Rockaway Inlet and those waters having their outlet in Dead Horse Inlet, with a view to framing a plan for their improvement and recommending the order of such improvement with the cost thereof, and to recommend the proportion of such cost to be borne by the city of New York; and the Secretary of War is hereby requested to confer and cooperate with the commissioner of docks and ferries of the city of New York, or with any other duly authorized agents, officers, or representatives of the city of New York, and with any commission of engineers appointed, or who shall hereafter be appointed, to survey or examine said bay and to recommend to the city of New York, plans for the improvement of said Jamaica Bay or the lands in and about said bay.

The conference and cooperation directed were had by me, and only with the Jamaica Bay Improvement Commission, whose appointment rendered conference and cooperation with other agents of the city of New York unnecessary.

The commission was originally appointed April 26, 1906, for the purpose of reporting upon the general improvement and development of Jamaica Bay, and also upon the condition of the water front of the city of New York other than that of Manhattan Island. It submitted its report May 31, 1907, and expired June 1, 1907; but was reappointed June 7, 1907, and to its original duties was added that of conferring with the Secretary of War relative to the survey or examination of Jamaica Bay, and to recommend plans for the improvement thereof.

The commission has placed at my disposal copies of its report of May 31, 1907, and all surveys made or information collected by it which would aid me in the examination of Jamaica Bay, in minimizing the attendant expense, and in preventing duplication of work. These have been of great assistance and freely used in the preparation of this report.

Conferences have been freely had, mainly with a view to agreeing upon the location of a principal channel, but also relative to desirable secondary channels through the collection of islands lying in the central portion of Jamaica Bay.

Harbor lines limiting the principal channel on the west and north sides thereof have been in general agreed upon, subject to approval of higher authorities, but harbor lines limiting the principal channel on the east and south and the secondary channels should not be definitely determined until the data collected as to tidal range and discharge have been digested, with the view to determining allowable limits to encroachment upon the tidal basin. The maintenance of the capacity of this basin necessary to secure a maximum tidal scour through the entrance is all-important in the absence of any appreciable fresh-water discharge.

This study will require time. Its results will be of importance when the establishment of harbor lines other than those on the west and north side of the principal channel are under final consideration by the War Department, but are not essential to this report. The improvement of Jamaica Bay to the west and north of the principal channel will naturally be undertaken long before that of the islands in the bay, and will itself be a work of years.

What are the commercial and other interests, present and prospective, which may justify the improvement under consideration? The answer is, the commerce of the port of New York and the wharfage and other terminal facilities needed therefor.

Custom-house statistics for the port of New York for the calendar year 1908 are as follows:

	Net tonnage.
Vessels entering from foreign ports (4,183).....	12,481,861
Vessels clearing for foreign ports (4,061).....	12,327,372
Value of imports—those for December estimated at \$60,000,000.....	\$641,552,984
Value of domestic exports—for December estimated at \$48,000,000.....	\$614,489,283
Value of foreign exports—for December estimated at \$950,000.....	\$12,109,823
Duties collected—for December estimated at \$16,695,244.....	\$176,552,892

In addition, it is estimated that commerce valued at about \$2,000,000 passes through New York monthly in transit to other countries without being landed, and about \$500,000 per month of Canadian products are held in bond in passing through the United States to other countries. These statistics are for the port of New York, only including Jersey City, but not Newark and the Amboys.

The increase, in twenty years, of tonnage entering and clearing was 121 per cent.

The report of the Chamber of Commerce of New York for the year ending June 30, 1908, states that three-fourths of all the sugar imported enters the port of New York; nearly three-fourths the coffee and nearly one-half the tea; considerably more than three-fourths of all the cotton, silk, and wool manufactures; 96 per cent of all the India rubber; nearly 60 per cent of the hides and skins; and over 80 per cent of the tin.

Mr. Elmer L. Corthell stated to the Eighth International Navigation Congress at Paris, France, that the total tonnage of the port of New York in 1899 was 79,544,000 tons, subdivided as follows: Interior, 25,093,000 tons; coastwise, 39,250,000 tons; foreign, 15,201,000 tons. The amount of foreign tonnage practically agrees with the amount reported by the United States customs service.

From the figures given by Mr. Corthell, it appears that the foreign trade of New York constitutes but 19 per cent of the total.

The Jamaica Bay Improvement Commission has platted the curve of foreign tonnage for the port of New York from 1853 to 1905, inclusive, and deduces from this curve that in 1915 this tonnage will amount to 21,366,300. Assuming interior and coastwise tonnage to increase in the same ratio, and the ratio of 19 per cent of these to foreign tonnage to continue, the total tonnage of the port will, in 1915, be 112,454,000 tons. To this the commission adds 10,000,000 tons, which is one-half of the estimated capacity of the New York barge canal, making a total of 122,454,000 tons, as against 79,544,000 tons for 1899.

The commission believes this a conservative assumption. That it is so is in part demonstrated by the fact that the 1908 foreign tonnage of New York was 24,809,233 tons (December tonnage estimated), and the 1907 tonnage 25,093,686 tons. Assumptions have been made as to rate of increase of tonnage, be it interior, coastwise, or foreign; but the records of the customs service, freed from all assumptions, show that in 1885 the foreign tonnage entered and cleared at New York was 11,100,457 tons; and in 1907, 25,093,686 tons. In other words, in twenty-two years there was an increase of 126 per cent.

What has been the increase in wharfage to meet the increase of tonnage? What wharfage will be provided by the improvement under consideration?

Mr. William G. Ford, a member of the Jamaica Bay Improvement Commission, has kindly placed at my disposal information gathered by him relative to these subjects and to others considered in this report.

It appears that prior to 1901 data as to wharfage construction were not collected with accuracy; but that from 1901 to 1907, both years inclusive, 125,605 linear feet of wharfage were torn out and 250,666 feet constructed, showing a net gain of 125,061 feet, or a mean annual gain of 17,867 linear feet or 3.38 miles. During the same period, the tonnage of foreign commerce increased from 16,797,700 tons to 25,093,686 tons, an increase of 50 per cent.

These figures show an increase of wharfage of 100 per cent during a period of increase of foreign tonnage of 50 per cent. It is not reasonable to suppose that in future years the increase of wharfage will be

double the increase of foreign tonnage. So an attempt must be made to determine from other considerations than relative increase of tonnage what increase in wharfage must be provided.

The information in the two following paragraphs is taken from an editorial in the *Engineering Record* of July 4, 1908:

The present available wharfage of the port of New York is about 1,000,000 linear feet; of this only about 10 per cent is given to ocean-going vessels. Most of the increase of wharfage of that port for the past ten years is to accommodate this class of vessels. Only certain tracts of the Brooklyn and Staten Island shores were found to be available without very great expense for increase of wharfage on upper New York Bay. These tracts aggregate about 50,000 feet of water front and could be made to provide 250,000 feet of wharfage. The board of street and water commissioners of Newark, N. J., believes that, together with what will be made available on the Hudson River, will probably provide wharfage room to care for all requirements for the next fifteen years.

"One method of arriving at the probable requirements for a port of foreign shipping is through a study of the imports and exports of some existing port, and their relation to the growth of the manufactures of the vicinity. It has been found that the increase of foreign tonnage follows very closely the growth of the value of manufactures in the United States and applies to many of the coast cities. The probable future value of manufactures can, therefore, be taken in arriving at the probable needs for foreign shipping facilities at any date in the future."

I have followed a method proposed for determining the amount of future tonnage from the value of manufactures, which results in the following per capita values and tonnage:

Per capita.	Imports.	Exports.
Value.....	\$58. 30	\$66. 37931
Tonnage.....tons..	1. 4575	1. 106322

Or a total per capita export and import tonnage of 2.563822 tons.

But the total like tonnage for New York, when divided by the population of that city for the years 1890, 1900, and 1905, gives respectively, 4.90, 4.66, and 4.72 tons.

It seems futile to attempt to determine with any precision what will be the commerce of New York at some distant date, what will be the necessary wharfage to accommodate it. New York will increase in population and in manufactures; but both will be spread over an area extending to Yonkers on the north, to the western end of Long Island Sound in the northeast, and including Jamaica Bay on the east. The increase of tonnage of the port of New York can not be measured by an increase in population of this large area, which, though consolidated in one municipality, must for many purposes have lesser semi-independent objectives.

We can say that this tonnage will greatly increase and that it is thought that in ten years available water fronts for wharfage around Manhattan and in upper New York Bay will be exhausted. Provision for additional frontage must be made, which provision should be on New York Bay if practicable, and Jamaica Bay affords the only site for such addition.

With reference to this section, Edward M. Grout, ex-comptroller of New York City, stated—

if properly developed this area would produce 120,000 feet of bulkhead around the mainland, and depending upon the channels to be laid out would have, in addition, from two to three times that number of feet of bulkhead around the land to be filled in within the limits of the bay.

He thought it desirable that a—

plan for the general improvement should first be determined upon and bulkheads constructed, in order that the excavated sand may be utilized for filling in behind the city's bulkheads, rather than to be used by the contractor for reclaiming private land.

Such a plan, shown in part on map accompanying this report, has been developed by the Jamaica Bay improvement commission, and in harmony with it is the plan now presented for the improvement of waters in the bay, including its entrance, and those waters having their outlet in Dead Horse Inlet.

A channel 43,000 feet long measured along the westerly and northern pierhead line is provided, giving access to 80 piers on the mainland, assuming piers to have a normal width of 125 feet and slips a like width of 300 feet. If the piers are built at an angle of 45 degrees with the bulkhead line, each will be 1,000 feet long. Hence 160,000 linear feet of wharfage may be constructed.

The improvement later of the islands within the bay may be so planned as to provide more wharfage than the amount provided along the mainland shore.

Plans for developing the lands lying in the interior of the bay are still under consideration, and for reasons above given they may well be delayed. Relief to commerce for many years will be provided, if so much of the plan as relates to the mainland is carried out.

It is, however, here suggested that the secondary channels through the islands should radiate from the entrance of the bay, and should be so located as to limit the number of drawbridges in the railroad crossing the bay to two. One channel might run from the entrance to the bridge crossing the main north channel; another to the bridge crossing the south or Beach channel, and, after passing the bridge, divide into two, of which one should run northeast, the other follow Hassock channel eastward.

Congress might well declare to be nonnavigable waters of the United States all channels meandering through the islands within the bay other than the secondary channels to be agreed upon at some future date. The War Department should issue no permits for structures on or across navigable waters of the bay, whose existence would not be in harmony with the scheme of secondary channels to be formulated.

The plan for improving the waters of Jamaica Bay, other than the secondary channels, contemplates affording an entrance to the bay of a minimum width of 1,500 feet and depth of 30 feet at mean low water, and a main channel following the western and northern limits of the bay, which channel is to be 1,000 feet wide and 30 feet deep.

For some years the widths of the entrance and the main channel need not be greater than 500 feet and their depths 18 feet, as the principal use for that time of these channels will be to afford a water way for vessels bringing in material for wharf and other structures, whose construction must precede the ultimate development of the improvement.

The direction recommended for the entrance channel off Rockaway Point is northeasterly, thence easterly to its connection with the main channel. This line follows the deep-water channel now existing. A shoal lies to the east of this channel south of Rockaway Point, which shoal is connected by a bar with the shoal to the northwest of the channel. It is proposed to dredge through this bar in the line of the existing channel prolonged.

Comparison of surveys shows a progressive movement of Rockaway Beach westward, and this may ultimately necessitate a jetty running southwesterly from Rockaway Point to diminish the shoaling of the proposed channel. Later another jetty may be required to prevent like shoaling by sand from the west, but the necessity of its construction remains to be demonstrated. Dredging alone should be first resorted to, to provide a depth of not more than 18 feet over the bar. The eastern jetty should be built so soon as necessary to the economic maintenance of the channel of 18 feet or greater depth, and finally, should like maintenance of channel demand, the western jetty.

The eastern jetty is planned to extend to the 18-foot curve at a point where the shoal drops suddenly to a depth of 36 feet. This will bring it to a line at which the shoal formation seems to end, or to what has been termed the neutral axis. But it can not be asserted that this axis will not move seaward with the construction of the jetty.

No neutral axis is defined to the west of the entrance channel; hence the ultimate length of the west jetty can not now be determined. It is tentatively located, to start from the eastern half of Manhattan Beach of Coney Island, and extend southward to the 30-foot curve. But, as before stated, the necessity of the construction of this jetty is not yet demonstrated. The eastern jetty may prevent the increase of the shoal off Coney Island, and this shoal may even be reduced by the action of the sea.

The cost of the western jetty is only included to present, as far as is now foreseen, the possible total cost to the United States of the proposed improvement.

The order of so much of the plan of improvement above outlined as should be executed by the United States is:

First. Dredge a channel 18 feet deep and 500 feet wide through the entrance as far as the southeast corner of Barren Island; in other words, to the beginning of the main channel.

Second. Maintain this entrance channel.

Third. Increase this channel to a width of 1,500 feet and depth of 30 feet.

Fourth. If in maintaining this channel it be found advisable to construct the east jetty, do so under continuing contract, for once its necessity is determined, economy of construction will demand continuous, speedy work.

Fifth. Construct the west jetty, gradually extending it to such length as may be found advisable.

Dredging the main channel is not included above for reasons which will be given later.

The 18-foot channel should not be dredged until the Secretary of War is satisfied that the city of New York is prepared to undertake the dredging of the main channel to a like depth.

What is the cost of the improvement proposed, and of its maintenance?—The ultimate cost of the improvement, so far as now foreseen, is estimated at \$8,610,050, as follows:

Dredging the 18-foot entrance channel, allowing 1 foot for overdepth; removing 835,000 cubic yards, place measurement, at 30 cents.....	\$250, 500
Widening and deepening this channel, 10,165,000 cubic yards, place measurement, at 10 cents.....	1, 016, 500
East jetty, estimating 1.5 short tons per cubic yard for voids and settlement, 483,000 tons, at \$1.50.....	724, 500
West jetty, 393,000 tons, at \$1.50.....	589, 500
Contingencies, 5 per cent.....	129, 050
Dredging main channel, 59,000,000 cubic yards, at 10 cents.....	5, 900, 000
Total.....	8, 610, 050

The cost of maintenance can only be roughly estimated. Experience alone will determine the cost of repairs of jetties, which will vary with storms and other causes of subsidence. It is probable that the bar at the outer end of the entrance channel will re-form, but at what rate can not be predicted. Assuming that it will regain its present dimensions in three years, an average of 278,000 cubic yards must be removed annually, which, at 20 cents per yard, will cost \$55,600.

The tentative estimate of annual cost for maintenance is assumed thus at \$55,600.

What proportion of the cost of the improvement is to be borne by the city of New York?—Before making recommendation as to this, it may be well to summarize the estimates so far reported by the Jamaica Bay Improvement Commission of the cost to the city of New York of the plans for the development of Jamaica Bay, including both the creation of channels and the reclamation of land.

These estimates are taken from the majority and minority reports.

Majority report.

Filling 106,491,300 cubic yards, at 10 cents.....	\$10,649,130	
Bulkheads:		
12,140 feet, at \$72.....	\$874,080	
65,650 feet, at \$16.....	1,050,400	
		1,924,480
Sand embankment with riprap slope, 193,230 linear feet, at \$2:40.....		463,750
Land:		
431 acres, at \$750.....	323,250	
To be purchased for grading streets, 315 acres, at \$650....	204,750	
		528,000
Total.....		13,565,360

Minority report.

Dredging 281,500,000 cubic yards, at 12 cents.....	33,780,000	
Filling 280,000,000.....		
Bulkhead, 301,975 feet, at \$25.....	7,549,375	
Engineering, inspection, and administration.....	1,000,000	
Land, 6,800 acres, at \$700.....	4,760,000	
		47,089,375

The less expensive types of bulkheads must ultimately be replaced by others of greater permanency.

These estimates cover only what may be termed the initial expense to the city; that of the majority differs from the minority estimate in providing no wharves on the islands within the bay and in assuming a main channel of 20 feet depth instead of 25 feet.

Both majority and minority reports indicate auxiliary channels and basins.

Sufficient has been stated to show that if the city of New York enters upon the execution of either of the plans outlined it will face the expenditure of millions of dollars for works beneficial to both the United States and the city.

The dividing line between the works for the improvement of navigation to be executed by the General Government and by the city, should, it is thought, be such that the General Government will pro-

vide the main waterway and the city the auxiliary waterways and basins.

The commission's plans contemplate the use of dredged material to fill lands behind bulkheads or embankments to be constructed by the city. Complications with government contractors are sure to arise, when an attempt is made to coordinate areas of dredging with areas of fill, at varying distances each class from the other, the areas of dredging to be indicated by the Government, the areas of fill to depend upon the construction of embankments or bulkheads by the city.

The commission reports that "by an arrangement with the city to the effect that dredgings from the bay could be placed upon the city's land, the cost to the Government would be but 10 cents." Such an arrangement would be to the interest of the Government, though as above outlined, difficulties would arise in its execution which can best be surmounted by one party having charge of both the dredging and the filling.

I therefore recommend that the dredging of the main channel be required of the city of New York and that the city be reimbursed therefor at the rate of 10 cents per cubic yard place measurement for all material dredged within the limits of the main channel to the extent of \$5,900,000, less cost to the Government of superintendence, surveying, and inspecting.

The main channel commences at the inner end of the 1,500-foot entrance channel, includes all widenings at angles, and terminates at the mouth of Cornells Creek. Five million nine hundred thousand dollars is the estimated cost of dredging this channel to a depth of 30 feet. Any cost of dredging this channel in excess of this estimate reduced by cost of superintendence, etc., should be borne by the city. The city should not be reimbursed for any material dredged from below a depth of 30 feet below mean low water, as determined by the United States engineer survey of 1908.

Summary.—The plan of improvement of the waters of Jamaica Bay, including entrance to said bay at Rockaway Inlet and those waters having their outlet in Dead Horse Inlet, as recommended is to provide ultimately an entrance channel 1,500 feet wide and 30 feet deep through Rockaway Inlet to a main channel within the bay which shall be 1,000 feet wide, except where widened at angles, and 30 feet deep; auxiliary interior channels in general direction as indicated above; and if needed two stone jetties at the mouth of the entrance channel, one extending from the western end of Rockaway Beach, the other from the eastern half of Manhattan Beach, Coney Island.

The order recommended of such improvement is first, to dredge the entrance channel for a width of 500 feet to a depth of 18 feet, as outlined above in last paragraph of section 9; second, to maintain this channel; third, widen and deepen this channel in proportion to the demands of commerce, ultimately to a 1,500 foot width and 30 feet depth; fourth, construct east jetty, when its necessity is determined; fifth, construct west jetty, as necessity is determined.

The proportion of the cost to be borne by the city of New York which is recommended is the cost of dredging all auxiliary interior channels and basins, and any cost of dredging the main channel in

excess of \$5,900,000, which sum, less expense to the United States for superintendence, surveying, and inspecting, is to be paid to the city for material actually dredged from the main channel within the prescribed limits, it being understood that the city shall dredge the main channel to the dimensions stated and shall receive no other reimbursement therefor from the United States except the sum stated.

It is further recommended that Congress declare nonnavigable those waters which lie between the islands within Jamaica Bay, but do not lie within the limits of such waterways as may be improved by the city of New York, on plans recommended by the Chief of Engineers, and authorized by the Secretary of War.

As above outlined, I believe the waters of Jamaica Bay, including entrance to said bay at Rockaway Inlet and those waters having their outlet in Dead Horse Inlet to be worthy of improvement by the General Government.

Very respectfully, your obedient servant,

JOHN G. D. KNIGHT,
Colonel, Corps of Engineers.

The CHIEF OF ENGINEERS, U. S. Army.

[Second indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C., February 23, 1909.

Respectfully returned to the Chief of Engineers, U. S. Army.

The within is a report of the district officer on the subject of the improvement of Jamaica Bay, New York, made after a survey of the locality and conferences with the Jamaica Bay Improvement Commission, representing the city of New York in this matter.

The object of the improvement is to provide additional facilities for handling the large and increasing commerce of the port of New York which is rapidly reaching a state of congestion, and which at the present rate of increase will within a few years exceed available facilities.

The scheme of improvement involves a deep-water entrance into the bay, the development of a main broad channel with auxiliary channels of lesser width, the bulkheading of the main shore and certain island areas, the filling behind the bulkheads, and the construction of wharves, slips, etc. It is proposed that the expense shall be borne in part by the city of New York and in part by the United States.

The total cost of development is not definitely known, but it involves many millions, as indicated by estimates of the Jamaica Bay Improvement Commission, which, in a majority and a minority report, places the cost on the part of the city of New York at \$13,565,360 and \$47,089,375, respectively, for work inside the entrance, including, however, only the dredging of channels, the building of bulkheads, the reclamation of low areas, and the purchase of lands. The district officer recommends with reference to this work that a proper share to be borne by the United States would be the estimated cost of the main channel, which he places at \$5,900,000. In addition to this work it is proposed that the United States provide the necessary channel of entrance, the maximum cost of which he estimates at \$2,710,050.

The plan proposed for securing a channel of entrance is—

First. To dredge a channel 18 feet deep and 500 feet wide through the entrance to the beginning of the main channel at the southeast corner of Barren Island, estimated cost.....	\$250, 500
Second. Increase the dimensions of this channel to 30 feet by 1,500 feet, estimated cost.....	1, 016, 500
Third. Construct east jetty if it proves to be necessary, estimated cost...	724, 500
Fourth. Construct west jetty if it should become necessary, estimated cost.....	589, 500
Contingencies.....	129, 050
Total.....	2, 710, 050

Owing to the character of the improvement the cost of maintenance of the channel can be given only approximately. The district officer places this item at \$55,600 annually.

In the opinion of the district officer it is possible that all the work outlined for creating a channel of entrance may not be necessary. He proposes to undertake the work tentatively by the inauguration of dredging operations and then the construction of the jetties later should experience prove one or both of these to be essential to the economic maintenance of the channel.

For reasons given within, the district officer believes that the 18-foot channel of entrance will serve the demands of commerce for some years, and recommends that even this should not be undertaken until the Secretary of War is satisfied that the city of New York is prepared to undertake the dredging of the main channel to a similar depth.

As stated above, it is proposed that the United States shall bear the cost of dredging the main channel 30 feet deep and 1,000 feet wide, but to avoid serious complications, the district officer recommends that the work be done by the city of New York in connection with the general development of the interior harbor and that it be reimbursed by the United States for the dredging done in excavating this main channel at the rate of 10 cents per cubic yard, place measurement, to an amount not exceeding \$5,900,000, less the cost of inspection and superintendence.

The magnitude of the commerce of New York is described in the report of the district officer, and its importance is a matter of such general knowledge that it does not appear necessary to enter upon this phase of the question again in detail.

As the Board was in doubt as to the amount of work which should be undertaken by the United States, it notified the mayor of the city of New York that it would be glad to have such representatives as might be designated appear before the Board and present such data and arguments bearing on the case as might seem to be desirable. In response to this notification, there appeared before the Board Mr. Nelson P. Lewis, city engineer of New York, Mr. W. G. Ford, of the Jamaica Bay Improvement Association, and Hon. Charles B. Law, M. C., from Brooklyn, N. Y. Mr. Lewis submitted at this hearing a partial estimate of cost to the city of the development. The estimate is inclosed herewith, and from this it appears that the ultimate development of the west and north shore of the bay only will cost somewhere in the neighborhood of \$70,000,000.

After careful consideration the Board is of the opinion that the United States should adopt a project of improvement consisting

of the entrance channel and a main interior channel, as outlined above. The Board is further of the opinion that the portion of the total expense to be borne by the city of New York should be any excess in the cost of excavating the main interior channel over 8 cents per cubic yard for 59,000,000 cubic yards (\$4,720,000). In reference to this item it may be stated that this unit price is believed sufficient to cover the cost to the city, taking into account the benefit accruing from the use of the material excavated as necessary filling to its adjacent dock property. The Board further recommends that the dredging of the main channel be done by the city of New York, and that the city be reimbursed therefor at the rate of 8 cents per cubic yard, place measurement, for all material dredged within the limits of the main channel to the extent only of \$4,720,000, less cost to the Government of superintendence, surveying, and inspecting, and that the city shall not be reimbursed for excavating any material from the main channel below the depth of eighteen feet until the United States has undertaken to increase the depth of the entrance channel beyond 18 feet.

The Board is also of the opinion that the improvement of the entrance channel should be prosecuted in the order given by the district officer as follows:

First. Dredge a channel 18 feet deep and 500 feet wide through the entrance as far as the southeast corner of Barren Island; in other words, to the beginning of the main channel.

Second. Maintain this entrance channel.

Third. Increase this channel to a width of 1,500 feet and depth of 30 feet.

Fourth. If in maintaining this channel, it be found advisable to construct the east jetty, do so under continuing contract, for once its necessity is determined, economy of construction will demand continuous speedy work.

Fifth. Construct the west jetty, gradually extending it to such length as may be found advisable.

The Board further recommends that the 18-foot entrance channel should not be dredged until the Secretary of War is satisfied that the city of New York is prepared to undertake its part of the general plan of improvement outlined above. The estimated cost of this channel for first development of 18 feet is \$250,500, and this is the amount of the first appropriation necessary under the conditions cited.

The ultimate cost to the United States of the plan proposed for adoption will be as follows:

(a) Main channel.....	\$4, 720, 000
(b) Dredging the 18-foot entrance channel.....	250, 500
(c) Widening and deepening this channel.....	1, 016, 500
(d) East jetty.....	724, 500
(e) West jetty.....	589, 500
(f) Contingencies	129, 050
Total.....	7, 430, 050

The cost of annual maintenance of the 30-foot entrance channel is estimated at \$55,600. It is to be noted that items (d) and (e) may not be necessary.

For the Board:

D. W. LOCKWOOD,
Colonel, Corps of Engineers,
Senior Member of Board.

LETTER OF THE CHIEF ENGINEER OF THE BOARD OF ESTIMATE AND APPORTIONMENT
OF THE CITY OF NEW YORK.

WASHINGTON, D. C., *February 23, 1909.*

GENTLEMEN: The estimates submitted to you to-day indicating the amounts which the city of New York would be obliged to expend in order to carry out the proposed partial improvement of Jamaica Bay were based upon the following quantities and prices:

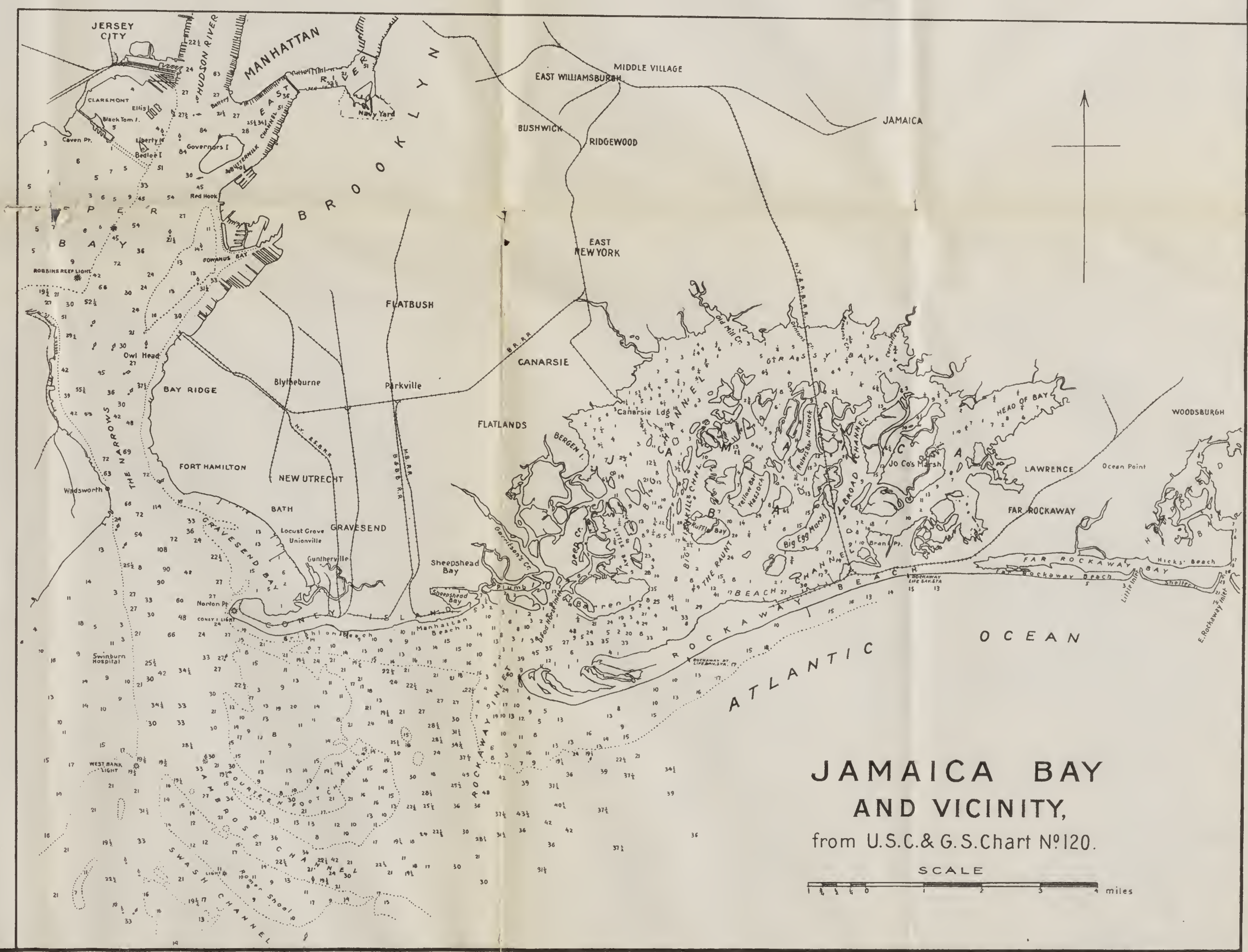
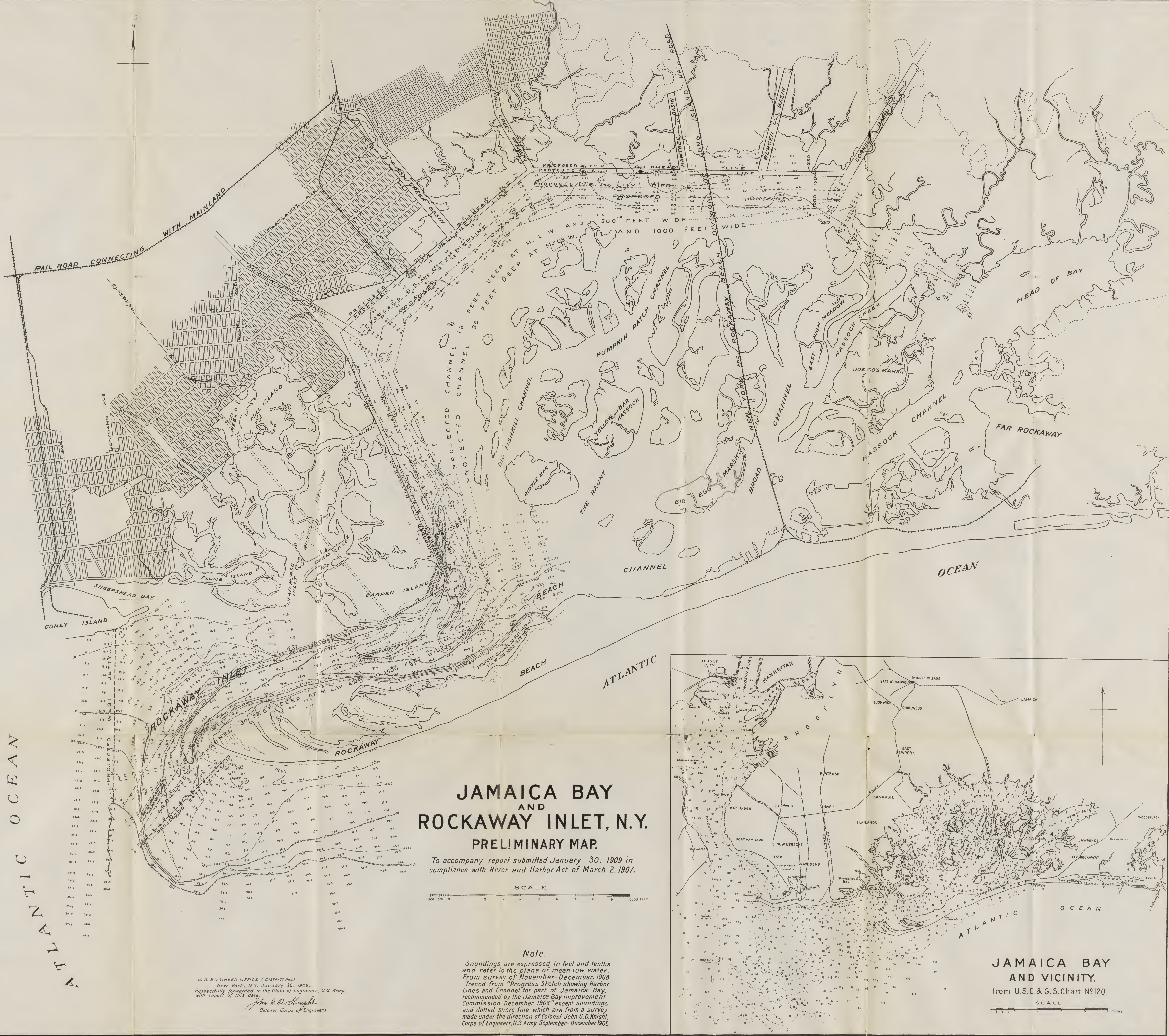
Dredging between the pier and bulkhead lines, at 12 cents per cubic yard.	\$7, 200, 000
Difference between the 8 cents and 12 cents per cubic yard for the main channel, provided the Government reimburses the city to the extent of 8 cents.	2, 360, 000
Bulkhead (timber) at \$25 per foot.	1, 187, 500
Bulkhead of concrete, at \$60 per foot.	2, 850, 000
3,000 acers of land.	4, 500, 000
112 piers of Chelsea type.	31, 360, 000
Sheds for same.	21, 000, 000
Total for timber bulkheads.	67, 600, 000
Total for concrete bulkheads.	69, 270, 000

The above estimate includes the improvement of that portion of Jamaica Bay for which pier and bulkhead lines have already been tentatively approved by the board of estimate and apportionment of the city of New York, and extends from the south-easterly corner of Barren Island to a point some 7,000 feet east of the Long Island Railway trestle crossing Jamaica Bay.

Respectfully,
NELSON P. LEWIS,
*Chief Engineer, Board of Estimate and Apportionment
of the City of New York.*

The BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
Washington, D. C.





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